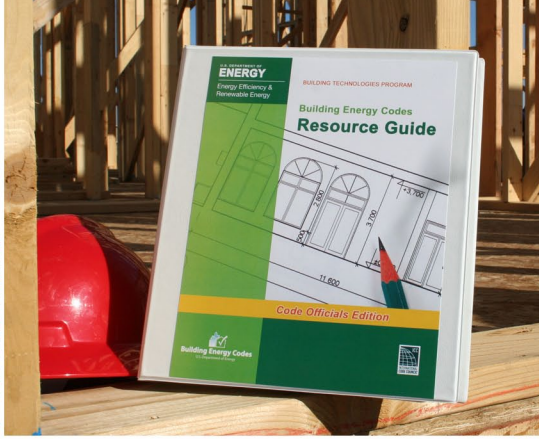
U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

BUILDING TECHNOLOGIES PROGRAM



2010 BUILDING ENERGY CODES
Annual Report

Building Energy Codes

30/30 VISION

BETTER CODES. BETTER BUILDINGS. BETTER PLANET.

Dear Stakeholders,

As our country attempts to reduce energy emissions in the face of global climate change, it is turning to the building sector for viable solutions. Residential and commercial buildings account for 40% of all U.S. energy consumption and more than 70% of electricity. Developing more efficient energy-saving codes for buildings is a major tool in improving building energy efficiency and reducing a substantial portion of U.S. energy consumption.

The U.S. Department of Energy's (DOE's) Building Energy Codes Program (BECP) was established in 1991 to improve residential and commercial building energy codes and standards. As a program area under DOE's Building Technologies Program, BECP activities contribute to energy-saving goals set by the Building Technologies Program. These goals support energy-efficiency goals established by DOE's Office of Energy Efficiency and Renewable Energy (EERE).

As directed by law, BECP's code development staff work with the primary code developers—the International Code Council (ICC) and the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)—as well as other energy efficiency advocates to drive building codes and standards toward higher levels of efficiency. In Fiscal Year 2010 (FY10), BECP made impressive progress in achieving DOE's goal of increasing the efficiency of residential energy codes by 30% by 2012. In collaboration with several outside parties, BECP staff developed and shepherded through the approval process code change proposals expected to result in a 2012 International Energy Conservation Code (IECC) that achieves a total estimated reduction in energy use of just over 30%.

BECP staff efforts, in partnership with other stakeholders, also resulted in proposed addenda to ASHRAE Standard 90.1-2010 that are expected to bring energy savings to nearly 25%, fast approaching DOE's 30% goal for commercial energy codes.

DOE's efforts to tighten residential and commercial building energy codes have resulted in new and updated homes and commercial buildings with reduced energy consumption, lower energy bills, and a smaller carbon footprint.

While code development is important, BECP recognizes that it is only the first step. State adoption of revised codes is equally critical for reaching needed building energy savings. To make adoption easier for states, BECP provides myriad tools and support, ranging from technical analyses of proposed state code amendments to code-compliance software. BECP efforts contributed to ten states adopting new residential energy codes that meet or exceed the efficiency of the 2009 IECC and twelve states adopting commercial energy codes that meet or exceed the efficiency of Standard 90.1-2007 in FY10.

Successful implementation of codes by builders and designers, and correct enforcement by code officials, delivers real impact through more efficient homes and commercial buildings. To enhance understanding and usability of codes for builders, designers, and code officials, DOE launched the largest energy code compliance study in history in FY10. In support of DOE's 90% compliance effort, BECP released a suite of resources, web tools, and recommended procedures to assist states in gathering data. It also initiated compliance measurement pilot studies in nine states. This effort will uncover new information about the real, on-the-ground impact of model energy codes.

The accomplishments BECP made during FY10 are detailed in this report. We thank our stakeholders and collaborators for their continued support, as well as the citizens of our nation who have participated in the process and for whom increased energy efficiency continues to make a difference.

Sincerely,

Saralyn Bunch

Saralyn Bunch, Building Energy Codes
U.S. Department of Energy

WHAT'S INSIDE

RESIDENTIAL CODES
Impacting Code Development, Adoption, and Compliance

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30/30 Vision: The Goal Comes into Focus

In the world of residential building efficiency, Fiscal Year 2010 (FY10) marked the heart of the development cycle for the 2012 version of the International Energy Conservation Code (IECC). The U.S. Department of Energy's (DOE's) Building Energy Codes Program (BECP) provided the underlying building science—and engaged in collaborative partnerships—to propose code changes and address an extensive set of public comments on draft versions of the 2012 IECC. Throughout the process, DOE's *Residential 30% Codes Initiative* has provided the important and challenging goal of achieving a 30% increase in residential energy savings in the 2012 IECC over the 2006 IECC baseline. The 2009 IECC is estimated to achieve 12 to 15% improvement in energy savings; however, the true heavy lifting comes in achieving the remaining 15 to 18 percentage points.

To this end, FY10 was a busy year. By applying expertise in the fundamental building sciences, as well as impact analyses of each proposed code change and their cumulative nationwide effect, BECP staff developed several IECC code change proposals and collaborated with a number of outside parties that were developing related proposals. Following the International Code Council's (ICC's) Initial Action hearings in October 2009, a collection of proposed changes recommended for approval by the IECC Code Development Committee was estimated to achieve the 30% savings goal. The proposed changes included improvements to traditional efficiency requirements, such as higher R-values for insulation and lower solar heat gain coefficients for windows, but also delved into some new areas. DOE's flagship EC13 code change proposal moved toward 30% savings in the following areas:

- A mandatory envelope air tightness test in all homes, with a stringent required score
- A requirement that ducts be tested to a tighter duct leakage standard
- A set of options to solve the problem of "stranding," and therefore wasting heated water—use small diameter pipes, or insulate pipes to avoid waste.

These provisions were approved at the IECC Final Action Hearings with an overwhelming majority vote. The resulting 2012 IECC is expected to achieve **a total estimated reduction in energy use just over 30%**. Realizing these final percentage points in proposed code is a major accomplishment for BECP and all organizations involved—and

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one that will reap vital economic and environmental benefits for the nation. Looking ahead, a new *Residential 50% Codes Initiative* will require further breakthroughs in implementing advanced construction technologies and techniques, and perhaps the establishment of new paradigms in how residential energy codes work.

2009 IECC—DOE Preliminary Results

In addition to helping push the IECC toward greater efficiency, BECP is tasked with determining whether energy is saved by each new version. On September 3, 2010, DOE published a notice in the *Federal Register* releasing DOE's preliminary determination that the 2009 IECC does indeed save energy compared to its 2006 predecessor for residential buildings. If the determination is finalized, states would be required to evaluate whether it is appropriate for them to update their building codes to meet or exceed the 2009 IECC.

"The building technological changes that stick have always been evolutionary; they have not been revolutionary. We should be calm, deliberate, and forward-moving—looking for fundamental, simple, and direct changes year after year, not magic bullets."
Joseph Lstiburek, Ph.D, P.Eng, and ASHRAE Fellow

Setting Standards for Manufactured Housing

While energy codes and standards for site-built housing have been a major focus of efficiency efforts in recent years, standards for manufactured housing have not changed since 1994. In FY10, BECP conducted technical analyses in order to draft new energy standards for manufactured homes. Through collaborations with key leaders in government and industry in FY10, BECP published an Advance Notice of Proposed Rulemaking, requested public comments, and began addressing those comments to develop a Notice of Proposed Rulemaking. This document is scheduled to appear in the *Federal Register* for further public comments during FY11. The goal of this process is to develop standards that will lead to more affordable, comfortable, and efficient energy use in manufactured housing.

Making Adoption Easier

The key to real impact is adoption of new codes by states, territories, and local jurisdictions. During FY10, ten states adopted new residential energy codes that meet or exceed the efficiency of the 2009 IECC. To take this step, states must feel confident that new codes and amendments to codes will lead to energy efficiency improvements and that a reliable source of solutions and tools exist for constituents who will use the codes. BECP facilitates code adoption by providing a robust technical support infrastructure to help states feel confident in taking the next step. Specific FY10 actions included formal technical assistance to adopting states, such as reviews of legislative and regulatory language, technical analysis of proposed state code amendments, and response to over 1200 residential help desk inquiries.

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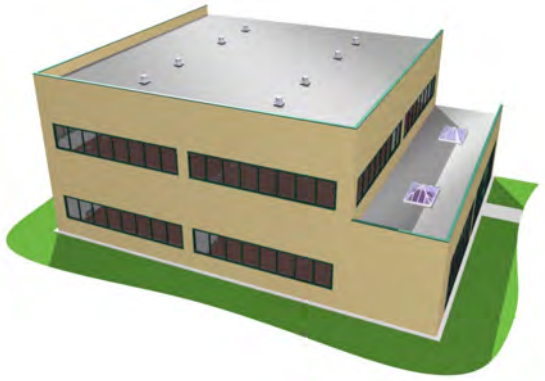
COMMERCIAL CODES
Impacting Code Development, Adoption, and Compliance

30/30 Vision: Indicating Performance

FY10 was an active development period for commercial energy codes ANSI/ASHRAE/IESNA[1] Standard 90.1 and the commercial chapter within IECC. To deliver improved efficiency, BECP's commercial building energy experts played an active role in both cycles by serving on ASHRAE committees and helping develop Standard 90.1, collaborating with other stakeholders to build support for IECC code change proposals, and delivering key building science contributions. These actions included the following:

- **Releasing and updating** an ongoing "Progress Indicator" that tracked the percentage of energy savings of Standard 90.1-2010 compared with the baseline of Standard 90.1-2004. Using state-of-the-art modeling techniques in sixteen building prototypes across the nation's climate zones, BECP incorporated each proposed addendum to calculate site energy savings. At the end of FY10, the Progress Indicator savings from the addenda proposed in Standard 90.1-2010 were nearing the 25% mark.
- **Working with** the New Buildings Institute and the American Institute of Architects to develop and build support for EC147, a major proposed overhaul to the IECC's commercial energy provisions. EC147 includes a cool roof requirement, as well as flexibility to achieve compliance through more efficient HVAC, lighting, or the incorporation of onsite renewable energy generation to realize impactful savings.



[1] American National Standards Institute/American Society of Heating, Refrigerating and Air-Conditioning Engineers/Illuminating Engineering Society of North America

Many of these energy-saving changes in Standard 90.1-2010 and the commercial chapter of the 2012 IECC were developed with input from BECP, including:

- **New building envelope requirements:**
  - Daylighting and daylighting controls
  - Minimum skylight areas in some occupancies
  - Cool roofs in climate zones 1 to 3
  - Continuous air barriers
- **New lighting requirements:**
  - Differentiation of exterior lighting power by location (urban, suburban, rural, national parks)
  - Daylighting controls (a proposed first-ever mandatory control in a national model code)
  - Interior and exterior lighting controls, including more widespread occupancy sensors
  - More occupancy sensors and after hours dimming/shut-off of exterior lighting
  - Revised Lighting Power Densities to reflect improved efficacy and model corrections (Standard 90.1 only)
- **New mechanical requirements:**
  - Expanded economizer
  - HVAC commissioning on larger pieces of equipment
  - More use of motorized outside air dampers
  - More stringent chiller and Direct Expansion (DX) unit efficiency
  - Integrated Energy Efficiency Ratio (IEER) for DX units
  - Ventilation reset
  - Energy recovery ventilation in more climates and applications
- **Integration of a renewable energy option into IECC code compliance (IECC only).**

Building Commercial Adoption

In FY10, a dozen states adopted new commercial energy codes that meet or exceed the efficiency of Standard 90.1-2007. For several of these states, BECP provided extensive reviews and suggested language on proposed amendments to the model codes to make sure efficiency is maintained in the final product. BECP also provides a robust technical support infrastructure to help states take the next step in code adoption. Specific FY10 actions included formal technical assistance to adopting states, such as reviews of legislative and regulatory language, technical analysis of proposed state code amendments, and response to over 1100 commercial help desk inquiries. One case study in state collaboration was the first-ever inclusion of Oregon's state-specific code into COM*check*™, including a live training webinar that helped Oregon prepare for its new commercial code during fall 2010.

Standard 90.1-2007—DOE Preliminary Determination Results

While working to develop Standard 90.1-2010, BECP staff also prepared a determination of how much energy was saved with each previous version. On September 3, 2010, the *Federal Register* published a notice releasing DOE's preliminary determination that site energy savings in Standard 90.1-2007 are estimated to be approximately 4.4% above Standard 90.1-2004. If this determination is finalized, states would be required to certify within two years of the final determination that they have reviewed the provisions of their commercial building codes, and as necessary, update their codes to meet or exceed the energy efficiency of Standard 90.1-2007.

Making New Rules

At the end of FY10, BECP was given responsibility for several new rulemaking tasks related to Federal buildings. Looking ahead, BECP staff will be active in:

- **Federal Sustainable Design Rulemaking.** Implement sustainable design principles for siting, design, and construction, with the additional goal of providing 30% of hot water load using solar heat if it is cost effective over the life cycle.
- **Federal Fossil Fuel-Based Energy Consumption Rulemaking.** New federal buildings and federal buildings undergoing major renovations must use less fossil-fuel-based energy, leading to 100% non-use by 2030.
- **Federal Baseline Standards Update.** Update the two private sector baseline standards in the federal building energy efficiency standards to the latest codes and standards that have a positive DOE determination of energy savings.

National Gypsum's Mt. Holly Plant in Charlotte, North Carolina, was part of the EC2010 building tour session.

30/30 VISION

ENGAGEMENT AND OUTREACH

Impacting Code Development, Adoption, and Compliance

Engaging Stakeholders

BECP evolved many of its traditional training and engagement activities through a more consolidated engagement and outreach approach during FY10. Collaboration and communication are key in moving impactful code changes from the development stage into adoption and compliance, and BECP continues to support these efforts by engaging in a multitude of national, regional, and jurisdictional venues.

Providing Value

In an attempt to better determine what assistance would have the most impact in helping states to "adopt, implement, enforce, and assess compliance with" current model building energy codes, DOE issued a formal Request for Information in FY10. Interested parties were solicited to provide suggestions, comments, and/or other related information.

BECP addressed the most substantive public responses by working with ICC and ASHRAE to provide no-cost electronic versions of the 2009 IECC and Standard 90.1-2007, respectively.

BECP also issued a Request for Proposals (RFP) to inject American Recovery and Reinvestment Act funds into the states. The RFP was released to states and territories for activities related to the adoption of, and compliance with, the most current building energy codes. Funding is anticipated to be provided through contracts, with the primary purpose to advance state building energy codes to the efficiency levels required by today's model codes and improve compliance rates at the state level.

Outreach to National and Regional Organizations

During FY10, BECP initiated an outreach initiative to collaborate with key national organizations. The purpose of this initiative was to identify the needs of the key groups' constituents with respect to energy codes and standards and collaborate with the groups on meeting those needs. This effort resulted in numerous presentations at national meetings such as the American Institute of

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Architects annual conference, and at the annual meetings of the Construction Specifications Institute and the ICC. Web presentations were held with the National Association of State Energy Officials, ICC, the National Governor's Association, and others. In addition to circulating energy codes and standards information through these organizations, connections were made between their websites and the BECP website.

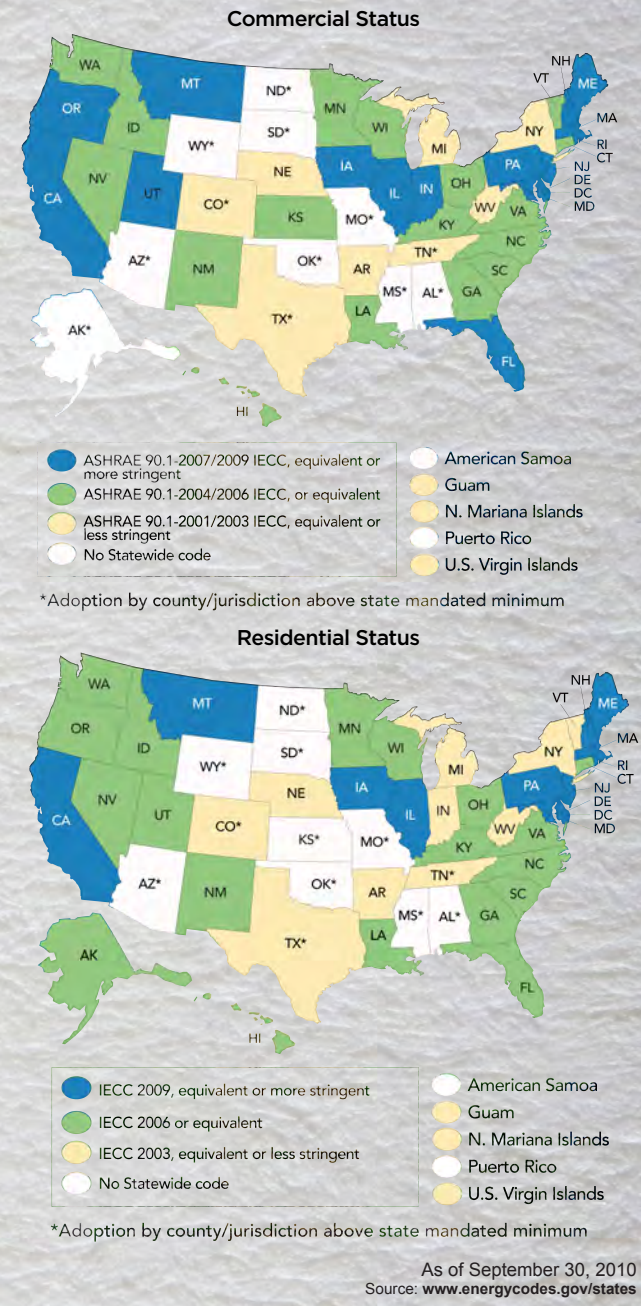
BECP also participated in the energy codes and standards conferences of five regional energy efficiency partnerships (EEPs), reviewed proposed adoption initiatives and code text in their states, and provided significant technical assistance that could be conveyed to the states.

Resource Guides

One of the many tangible results of BECP activities was the development of the Code Officials Resource Guide, the first in a series of audience-specific tools to provide ready access to information for those engaged in all levels of the codes process. To support greater adoption and compliance with energy codes, BECP and ICC collaborated to publish a collection of each organization's most useful resources for code enforcement officials. The end product is a field-ready binder that code officials can take to actual jobsites, supporting their efforts to improve compliance rates within their jurisdictions. BECP and ICC collaborated to develop, publish, and disseminate these guides through ICC chapters around the country.

Energy Codes 2010

Energy Codes 2010, BECP's annual training event, was held in Charlotte, North Carolina, in July. Hands-on training and face-to-face networking were achieved through various training activities with members of the energy codes community. The event also represented a unique and impactful opportunity to bring together state energy office representatives and members of the building industry, facilitating discussion on current building energy code issues and providing consistent technical training on building energy codes and standards.



Energy Code Adoption Activity

REAL TOOLS FOR REAL COMPLIANCE

Impactful Tools to Support Adoption and Compliance

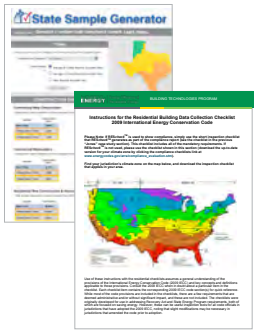
Tangible, Impactful Tools

BECP develops and makes available impactful tools that support the adoption of, and compliance with, IECC and ANSI/ASHRAE/IESNA Standard 90.1, which are the basis for most state codes. From code-compliance software, to compliance-specific guides and jurisdictional tools, to collaboration on no-cost availability of the 2009 IECC and Standard 90.1-2007, to hands-on training, BECP tools provide significant impact in code development, adoption, and compliance.

Measuring Compliance

Energy code compliance includes successful implementation by builders and designers, and accurate enforcement by jurisdictional code officials—both of which deliver real impact through more efficient homes and commercial buildings. The largest energy code compliance study in history—***DOE's 90 percent compliance effort***—was launched in FY10. To support states as they begin to gather data, BECP released a suite of resources, web tools, and recommended procedures, and also began compliance measurement pilot studies in nine states. This effort will uncover new information about the real, on-the-ground impact of the model energy codes.

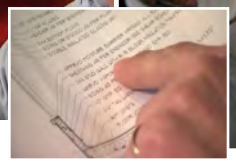
State Code Compliance Measurement Activity



Many U.S. states, territories, and jurisdictions are creating ways to measure and improve compliance with their energy codes. To support this effort, BECP released a report that provides BECP's recommended methodologies, which were developed with input from key stakeholders. BECP has provided the following materials to enhance state code compliance:

- Guidelines for measuring state energy code compliance
- Compliance checklists
- A step-by-step companion guide
- An online state sample generator
- Sample survey questions
- An online state energy code jurisdictional survey.

http://www.energycodes.gov/arra/compliance_evaluation.stm



Pilot Studies

BECP is working with national EEPs on pilot studies in nine states designed to measure code compliance.
http://www.energycodes.gov/states/maps/stateComplianceActivities.stm

As part of a code compliance measurement study, a statistically valid sample of buildings is required. To fill that need, BECP developed the State Sample Generator Tool. States can use this tool to quickly generate a random sample of residential and commercial buildings across climate zones in each state.
http://energycode.pnl.gov/SampleGen/

BECP also developed the State Energy Code Jurisdictional Survey, which is used to gather compliance information pertaining to energy codes, such as staff education and training, the amount of time spent on plan review and inspection, and the major impediments to achieving compliance.
https://survey.pnl.gov/se.ashx?s=4D1929A5207AB413

Software Tools

RES*check*™

Numerous enhancements to usability and report design have been implemented in RES*check*™ 4.4.0, including support for single users, multiple users, network installations, and data file locking to prevent simultaneous editing of data files. Outdated codes, including the 1992 to 1995 Model Energy Codes, the 1998 IECC, and the New Hampshire State Code are no longer supported, helping move towards newer more efficient codes across the country.
http://www.energycodes.gov/rescheck/download.stm

COM*check*™

The upgraded, COM*check*™ version 3.8.0 now supports:

- 2009 IECC
- Oregon state energy code
- New York 2009 IECC-based code.

Track and low-voltage lighting have also been added to the interior lighting area of the software. As with RES*check*™, numerous enhancements to usability and report design have been implemented, which include support for single users, multiple users, network installations, and data file locking to prevent simultaneous editing of data files. Outdated codes, including ASHRAE 90.1-1989, ASHRAE 90.1-1999, and 1998 IECC, are no longer supported.
http://www.energycodes.gov/comcheck/download.stm

BECP Website

BECP's website serves to engage, inform, and support the eight to ten million stakeholders in the U.S. building industry who put these codes into practice. Beyond its basic role in conveying relevant, timely content to audiences throughout the building industry, the site is the technical foundation upon which the program builds and delivers tools and resources to the codes community. The BECP website provides online software tools that simplify and clarify code compliance; the Building Energy Codes University, which offers training in a variety of formats and media types, ranging from self-paced online training to webcast events; and the status of building energy code adoption and compliance in all 50 states.
www.energycodes.gov

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The U.S. Department of Energy's Building Energy Codes Program is an information resource on national model energy codes. We work with other government agencies, state and local jurisdictions, national code organizations, and industry to promote stronger building energy codes and provide assistance to those who have an impact on energy code adoption and compliance.

BECP Website:
www.energycodes.gov

BECP Technical Support:
techsupport@becp.pnl.gov
www.energycodes.gov/help

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Building Energy Codes
U.S. Department of Energy

PNNL-SA-77054 • December 2010